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Research And Improvement Of Sleep Mode Scheduling Of Routing Protocol LEACH Using TEEN, APTEEN in WSNs

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***Abstract*— The distributed and dynamic topology of wireless sensor network (WSNs) introduces very special requirements in routing protocol. The most important features of a routing protocol, in order to be efficient for WSNs is the energy consumption and extension of network's lifetime. In this paper a brief introduction of the classification of routing protocols in WSNs along with the most energy efficient protocol named LEACH with its advantages & disadvantages. Finally this paper concludes with some comparison of protocols like TEEN,APTEEN with LEACH protocol.**

***Index Terms*— wireless sensor networks, Routing protocol, Reactive protocol, Proactive protocol, Sleep Scheduling, Energy Efficiency.**

I. INTRODUCTION

A wireless sensor network is a combination of many sensing nodes called wireless sensor nodes.Each node is small very less in weight and portable. The sensor nodes are work on the power source i.e. battery which is essential for its communication. The battery which is placed in remote area so it is not very easy to replace & recharge the battery after deployment. Thus the design and development of low energy algorithms and protocols are essential for sensor networks.

A sensor node is composed of typically four units.
1.sensing unit:- sense the desired data from the interestd region.
2.Memory unit:-store the data until it is sent for future use.
3.Computation unit:- Computes the aggregated data.
4.Power Unit:-Provides power supply for entire process

The WSN can be applied to a wide range of applications, such as environment management, environmental monitoring, industrial sensing. Infrastructure protection, battle field awareness and temperature sensing. So it is essential to improve the energy efficiency to enhance the quality of application service. Wireless sensor network routing protocols can be divided into flat routing and hierarchical routing protocol in the network structure. All sensor nodes in the flat routing protocol generally have the same function. However, the nodes in the hierarchical routing protocol play different roles .the high energy node in the hierarchical routing protocol is used to process and send a message, while the low energy of the node is used to sense the target area information. Hierarchical routing protocol has good scalability & as the efficiency, which is the focus of current research common hierarchical routing protocols LEACH,TEEN AND APTEEN so on.

Most of the protocols use clusters in order to provide energy efficiency and to extend the networks lifetime each cluster first elect a node as the cluster head (CH), and than the nodes in energy cluster send their data to their own cluster head. The cluster head sends its data to the base station. This data transfer can be performed in two alternative ways either directly in the case in which the cluster head is located close to the base station or via intermediate cluster heads in LEACH, a node becomes a cluster head using a stochastic mechanism this is prone to producing unbalanced energy level reverses in node and thus to increasing the total energy dissipated in the networks.

In this paper new protocol for energy consumption is presented and several comparisons have presented.

II. LEACH PROTOCOL

Heinzemen proposed the cluster base protocol called LEACH (Low energy adaptive cluster hierarchy) is the fundamental and most commonly used cluster based routing protocol. The main advantage of this routing protocol is improved the lifetime of WSNS by reducing energy consumption even distribution of energy among the nodes in networks and performing data aggregation are the main features of LEACH.

The operation of LEACH based on several rounds each round consists of setup phase and steady state phase. Each round in LEACH consists of two phases. During setup phase each sensor node tries to select itself as a cluster head according to probability model for selecting a cluster head

each sensor node generates a random number in between 0 and 1 if the number is less than the threshold T(n), the sensor node selects itself as a cluster head for current round. The threshold T(n) is presented as follows:

$$T(n) = \begin{cases} \frac{p}{1 - p * rmod(1/p)}, if n \in G \\ 0, otherwise \end{cases}$$

When p equals the suggested percentage of cluster heads r is the wound round and it is the set of nodes that have not been cluster head in the last 1/p rounds node which has been selected as cluster head will broadcast a message using CSMA, MAC protocol and non cluster head nodes will choose nearest cluster head to join that cluster..Now cluster head creates a TDMA schedule for each node in its cluster to transmit its data all nodes which are member of that cluster will send data to the cluster head according to the schedule. Finally the cluster head aggregate that data and send to the base station.

III. FIRST ORDER MODEL

Currently there is great deal of research in the area low energy radio. Different assumptions about the radio characteristics including energy dissipation in the transmit and receive modes will change the advantages of different protocols the first order radio model is used in leach the energy cost for transmit and receive k-bit message between two nodes separated by distance of d meters in LEACH given by equation

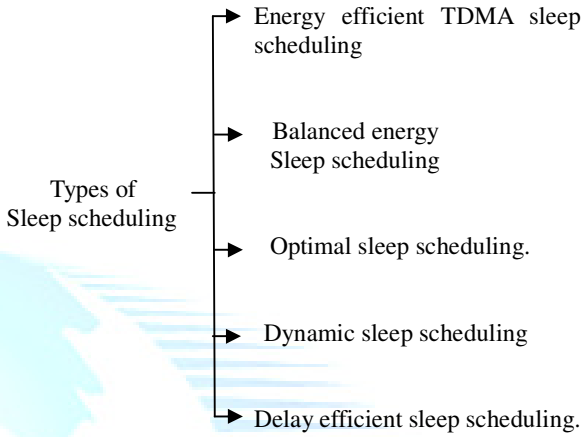
$$ETx(k,d) = kEelec + k \in fsd^2, if\ d < d0 \quad \text{..... (1)}$$
$$= kEelec + k \in mpd^2, ifd > d0$$
$$ERx(d) = kEelec \quad \text{..... (2)}$$

Where ETX(k,a) is the energy consumption in transmitting k bits data to a mode with distance of d,ERX(d) is thte energy consumption in receiving l bits data Eelec equals the per bit energy consumption for transmitter & receiver circuit.Emp and Efs are the amplifier parameter of transmission corresponding to multi path fading model and free space model respectively do is the threshold distance between multipath fading model and freespace model .

IV. NODE SCHEDULING

Any scheduling protocol will keep only a subset of notes to be in active state and keeping others in sleeping state. A scheduling protocol will be the best if it keeps only a minimum number of nodes active at any instant. The TDMA(Time Division Multiple Access) based Scheduling protocols make the nodes to be in sleep mode until their allocated time slots. The TDMA based protocols are designed such that the shortest path for communication will be found out and only a particular link will be in wakeup mode for a transmission.Any scheduling protocol for the WSNs for medium access control should have the following :

- Narrowband Modulation Techniques
- Good throughput efficiency
- Moderately low data transfer rate
- Less hardware complexity
- Low access delay and Low overhead



The TDMA based scheduling allocates seperate time slots.Each node to access the medium to send the sensed data or to forward the aggregated data.Here the formation of cluster head & cluster is same as in normal LEACH protocol. It differs when there is a procedure of scheduling nodes.In each cluster condition will be checked & if the condition will be satisfied then according to the given condition , the nodes are keeping in one of the two modes for certain time intervals. The condition is based on hard threshold (HT) & soft threshold(ST).

Hard Threshold(HT) : Hard Threshold is the threshold value for the first sensed attributes developed for reactive networks.It is the threshold value of the sensed attributes beyond which the node sensing this value must swirtch on its transmitter.

Soft threshold (ST): Soft threshold is little change in the value of the sensed attributes that triggers the node to switch on its transmitter and than transmit to it's CH.

A.Node scheduling using TEEN

A reactive network protocol called TEEN is Threshold-sensitive Energy Efficient sensor Network**.** In Reactive Networks, sensor nodes sense the environment periodically and transmit the value when the value exceeds a user specified threshold value that means when sensed parameter is critical. In this scheme, at each and every periodic time interval, in addition to the attributes, the CH broadcast HT and ST to its members. The nodes sense environment at regular basis. When the sensed parameter from the attribute set reaches its hard threshold value, the node switches on its transmitter and transmits the sensed information. An internal variable in the node stores the sensed value called SV. The nodes will next transmit the information in the current cluster period only when both the following conditions are correct. 1. The current sensed value of the sensed attribute is greater than previous sensed value that is HT. 2. The current sensed value of the sensed attribute

differs from previously stored sensed value (SV) by an amount equal to greater than the small change (ST).

The HT tries to reduce the number of transmission by allowing the nodes to transmit only when the sensed attribute is in the range of interest. The ST further reduces the number of transmissions by eliminating all the transmissions which have occurred because of little or no change in the sensed attribute once the HT decided. Energy consumption in this scheme can be much less than in proactive network that is normal LEACH. Because data transmission consumes more energy than data sensing and in this scheme data transmission is done less frequently. Advantage of this scheme is it is best suited for time critical data sensing application.

But the main drawback of this algorithm is that the nodes will not communicate with each other, if the thresholds are not reached and the user will not get any information about the network situation, and can not know even if the nodes will die. Therefore this scheme is not suited for applications where it is necessary to get data on a regular basis. To overcome the drawback of TEEN, advance protocol APTEEN is used.

B. Node Scheduling using APTEEN

A hybrid network protocol called APTEEN known as a Adaptive periodic threshold sensitive energy efficient sensor network protocol. Hybrid Networks gives the combination of best features of proactive and reactive networks, while reducing their drawbacks.

The user might need a network that reacts immediately to major changes in data and gives information about all situation of network periodically, so that it is able to answer analysis queries. None of the above sensor networks can do both jobs properly since they have their own limitations. APTEEN is combination of the proactive and reactive networks while reducing their drawbacks to create a new network called a hybrid network. In this network, the nodes not only send data periodically, they also respond to sudden changes in attribute values. In this way it works as a proactive protocol as well as reactive protocol. Data values exceeding the threshold value are known as critical data. The nodes monitors their environment at each and every time. Only those nodes which sense the value at or beyond the hard threshold can transmit. Furthermore, the next transmission will done after once a node senses a value beyond HT only when the value of that attributes changes by an amount equal to or greater than the ST.

The exception to this rule is that a node is forced to sense and transmit the data to get the information about the network, irrespective to the sensed value of the attribute, if it does not send data for time period equal to the count time. But it consumes more energy, so another scheme. proposed.

C. PROPOSED Scheduling Node Scheme

Proposed scheduling node is a variable threshold in which value of threshold get changed after predefined round. This scheduling is variance of past sensed values. Constant soft threshold is the draw back of protocol TEEN and APTEEN because it gives the limited results. In proposed scheduling sc hem the soft threshold is not constant but varying with the sensed values. The sensed values are as per the count time, and the variations are taken by averaging (as per eq.4) these sensed values and then taking variance (as per eq.5)of these sensed values. These variations work as a soft threshold.

Avg. = sum of all sensed values/total sensed values ..(4)
Variance = Square root of (sum of (sensed value – avg.)2)/count ……..…(5)

Because of the variations in soft threshold, user gets a complete picture of the network at least one time in a count time. The node will be active at least one time as the soft threshold is the variance of all those sensed values and the node become active if it is in the range of the soft threshold. In this way the drawback of TEEN and APTEEN will overcome. The similar data that means the sensed value with little or no changes will not be transmitted to the CH so node is in sleep, there is no transmission. So the life time of nodes will increase and get better energy efficiency.

V .SIMULATION AND RESULT

The simulation parameters used in the experiment is shown below:
Number of sensor nodes (N)-2000
Network area (MxM)-100x100m
Eelect (transmission & reception energy per bit)-50nJ/bit
Eamp (amplification energy at transmitter per bit)
-0.0013pJ/bit/m4
Eda (data aggregation energy per bit) - 0.5J
K (number of bits in a packet) - 4000bits
Constant for free space energy - 10pJ/bits m2

For comparisons of normal LEACH with the improved LEACH the some results are taken. After 1000 rounds alive nodes are more in proposed adaptive threshold protocol than the normal LEACH. After 2000 rounds all the nodes become dead in normal LEACH, it runs up to 1853 rounds only and after completion of 1853 rounds remaining energy is also almost zero. APTEEN has 50 dead nodes and 34 J remaining energy. TEEN has 45 dead nodes and 54 J remaining energy. Proposed protocol has 38 dead nodes and 73 J remaining energy after 2000 rounds which is the best result compare to LEACH, TEEN and APTEEN.

Table:1-Comparision of protocols for dead nodes & remaining energy for 2000 rounds.

Protocols	No.of rounds used	Total dead nodes(out of 100 node)	Total remaining energy(out of 200J)
LEACH	1853	97	0.0223
TEEN	2000	45	54.6208
APTEEN	2000	50	34.1816
PROPOSED PROTOCOL	2000	38	73.3942

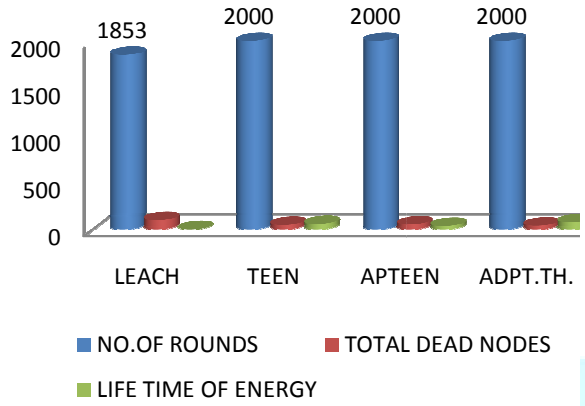


Fig: comparison for 2000 rounds

For more than 5000 rounds, Nodes become dead and energy get zero after completion of 1853 rounds in LEACH, 3803 rounds in APTEEN, 4311 rounds in TEEN and 6518 rounds in proposed protocol. So proposed protocol gives the best results compare to LEACH, TEEN and APTEEN.

Table:2-Comparision of protocols for dead nodes & remaining energy for more than 5000 rounds.

Protocols	No.of rounds used	Total dead nodes(out of 100 node)	Total remaining energy(out of 200J)
LEACH	1853	97	0.0223
TEEN	4311	99	0.0076
APTEEN	3803	99	0.0050
PROPOSED PROTOCOL	6513	99	0.0050

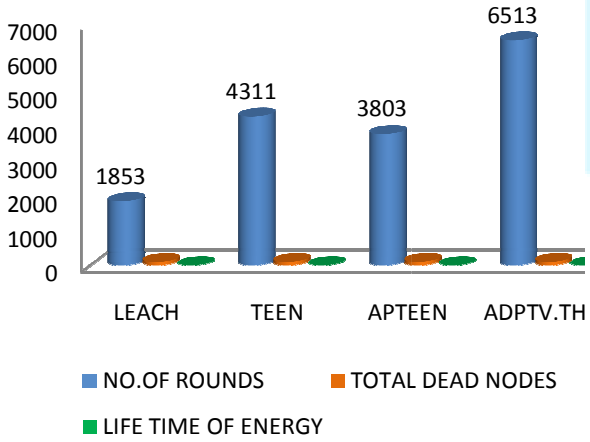


Fig: Comparision for more than 5000 rounds

V. CONCLUSION

In this paper,an energy efficient routing protocol with sleep scheduling for WSNs. Node sleep scheduling mechanism is highly energy efficient. Comparision with LEACH,TEEN & APTEEN proposed protocol works better .in this protocol sensor will try to adapt the environment changes by varying the threshold.

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